Claims

1. An image display device, in which one or more groups of particles are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the particles, to which an electrostatic field is applied, are made to move so as to display an image, characterized in that a member for transmitting a signal, which is supplied to circuits for an image display, is provided to the substrate by means of an anisotropic conductive film.

2. The image display device according to claim 1, wherein the anisotropic conductive film is formed by scattering conductive particles in a thermosetting adhesive or a photo-curing adhesive.

3. The image display device according to claim 2, wherein a diameter of the conductive particles scattered in the thermosetting adhesive or the photo-curing adhesive is 0.1 - 20 μm.

4. The image display device according to claim 2 or 3, wherein the thermosetting adhesive or the photo-curing adhesive includes one or more groups of compounds having one of glycidyl group, acrylic group and methacrylic group.

5. An image display device which comprises an image display panel and an optical function member, in which one or more groups of particles are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the particles, to which an electrostatic field produced by two groups of electrodes having different potentials is applied, are made to move so as to display an image, characterized in that the image display panel and the optical function member are integrated through a transparent elastic layer.

6. The image display device according to claim 5, wherein, when it is assumed that a refractive index of the transparent elastic layer is n_0, a refractive index of the optical function member is n_1 and a refractive index of the transparent substrate is n_2, an absolute of a difference between n_0 and n_1 and an absolute of a difference between n_0 and n_2 are not greater than 0.2 respectively.

7. The image display device according to claim 5 or 6, wherein the transparent elastic layer has a property such that, when it is assumed that a strain (ε_0) at 25 °C of a stress relaxation is 5 % and an initial value (after 0.05 sec) of a stress relaxation elastic modulus is G_0, G_0 is not greater than 6.5×10^6 Pa, and, a property such that a stress relaxation time τ calculated on the basis of a formula:

$InG(t) = - t/\tau + InG_0$

showing a relation between a stress relaxation elastic modulus G and a time t (sec) obtained from a damping curve of the relaxation elastic modulus, is not greater than 17 sec.

8. An image display device, in which one or more groups of particles are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the particles, to which an electrostatic field produced by two groups of electrodes having different potentials is applied, are made to move so as to display an image, characterized in that an anti-reflection layer having plural layers each indicating different refractive index is arranged on a surface of the transparent substrate.

9. The image display device according to claim 8, wherein the anti-reflection layer is constructed by stacking a low refraction layer produced by a sputtering process using a conductive silicon carbide as a target and a high refraction layer produced by a sputtering process using a conductive titanium oxide as a target.

10. The image display device according to claim 8 or 9, wherein the anti-reflection layer prevents a light reflection of which wavelength is 380 - 780 nm and a light reflection rate is not greater than 10 %.

11. An image display device which comprises an image display panel, in which two or more groups of particles having different colors and different charge characteristics are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the particles, to which an electrostatic field produced by a pair of electrodes arranged on one substrate or both substrates is applied, are made to move so as to display an image, characterized in that two substrates of the image display panel are connected by using a thermosetting adhesive or a photo-curing adhesive.

12. The image display device according to claim 11, wherein the thermo-setting adhesive or the photo-curing adhesive includes one or more groups of compounds having one of glycidyl group, acrylic group and methacrylic group.

13. An image display device which comprises an image display panel, in which two or more groups of particles having different colors and different characteristics are sealed between opposed two substrates, at least one of two

substrates being transparent, and, in which the particles, to which an electrostatic field produced by two groups of electrodes having different potentials is applied, are made to move so as to display an image, characterized in that one or more image display elements are formed by using a partition wall and the partition wall has such a shape that a bottom width wb at a side of an opposed substrate is larger than a top width wt at a side of a transparent substrate.

14. The image display device according to claim 13, wherein a ratio wt/wb between the bottom width wb at a side of the opposed substrate and the top width wt at a side of the transparent substrate is not greater than 0.5.

15. The image display device according to claim 13 or 14, wherein a color of the particles is white or black.

16. The image display device according to one of claims 1 - 15, wherein an average particle diameter of the particles is 0.1 - 50 μm.

17. The image display device according to one of claims 1 - 16, wherein the difference of a surface charge density in an absolute value between two groups of the particles measured by using the same kind of carrier in accordance with a blow-off method is 5 - 150 $\mu C/m^2$.

18. The image display device according to one of claims 1 - 17, wherein the particles are particles in which the maximum surface potential, in the case that the surface of particles is charged by a generation of Corona discharge caused by applying a voltage of 8 KV to a Corona discharge device deployed at a distance of 1 mm from the surface of the particles, is greater than 300 V at 0.3 second after the Corona discharge.

19. A method of manufacturing an image display device which comprises an image display panel, in which two or more groups of particles having different colors and different characteristics are sealed between opposed one substrate, at least one of two substrates being transparent, in which the particles, to which an electrostatic field produced by two groups of electrodes having different potentials is applied, are made to move so as to display an image, and, in which one or more image display elements are formed by using a partition wall, characterized in that the improvement comprises the steps of: forming the partition wall on one or both of a transparent substrate and an opposed substrate; arranging an adhesive at a tip of the partition wall; and connecting the partition

wall and the other substrate or both partition walls through the adhesive.

20. The method of manufacturing the image display device according to claim 19, wherein an average particle diameter of the particles is 0.1 - 50 μm.

21. The method of manufacturing the image display device according to claim 19 or 20, wherein the difference of a surface charge density in an absolute value between two groups of the particles measured by using the same kind of carrier in accordance with a blow-off method is 5 - 150 $\mu C/m^2$.

22. The method of manufacturing the image display device according to one of claims 19 - 21, wherein the particles are particles in which the maximum surface potential, in the case that the surface of particles is charged by a generation of Corona discharge caused by applying a voltage of 8 KV to a Corona discharge device deployed at a distance of 1 mm from the surface of the particles, is greater than 300 V at 0.3 second after the Corona discharge.

23. The method of manufacturing the image display device according to one of claims 19 - 22, wherein a color of the particles is white or black.

24. An image display device characterized in that the improvement is manufactured in accordance with the method of manufacturing the image display device set forth in one of claims 19 - 23.

25. An image display device, in which the liquid powders, which indicate a high fluidity in an aerosol state such that solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the liquid powders are made to move, characterized in that a member for transmitting a signal, which is applied to circuits for an image display, is provided to the substrate by means of an anisotropic conductive film.

26. The image display device according to claim 25, wherein the anisotropic conductive film is formed by scattering conductive particles in a thermosetting adhesive or a photo-curing adhesive.

27. The image display device according to claim 26, wherein a diameter of the conductive particles scattered in the thermosetting adhesive or the photo-curing adhesive is 0.1 - 20 μm.

28. The image display device according to claim 26 or 27, wherein the thermosetting adhesive or the photo-curing adhesive includes one or more groups

of compounds having one of glycidyl group, acrylic group and methacrylic group.

29. An image display device which comprises an image display panel and an optical function member, in which the liquid powders, which indicate a high fluidity in an aerosol state such that solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the liquid powders are made to move, characterized in that the image display panel and the optical function member are integrated through a transparent elastic layer.

30. The image display device according to claim 29, wherein, when it is assumed that a refractive index of the transparent elastic layer is n_0, a refractive index of the optical function member is n_1 and a refractive index of the transparent substrate is n_2, an absolute of a difference between n_0 and n_1 and an absolute of a difference between n_0 and n_2 are not greater than 0.2 respectively.

31. The image display device according to claim 29 or 30, wherein the transparent elastic layer has a property such that, when it is assumed that a strain (ε_0) at 25 °C of a stress relaxation is 5 % and an initial value (after 0.05 sec) of a stress relaxation elastic modulus is G_0, G_0 is not greater than 6.5×10^6 Pa, and, a property such that a stress relaxation time τ calculated on the basis of a formula:

$$\ln G(t) = - t/\tau + \ln G_0$$

showing a relation between a stress relaxation elastic modulus G and a time t (sec) obtained from a damping curve of the relaxation elastic modulus, is not greater than 17 sec.

32. An image display device, in which the liquid powders, which indicate a high fluidity in an aerosol state such that solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the liquid powders are made to move, characterized in that an anti-reflection layer having plural layers each indicating different refractive index is arranged on a surface of the transparent substrate.

33. The image display device according to claim 32, wherein the anti-reflection layer is constructed by stacking a low refraction layer produced by a sputtering process using a conductive silicon carbide as a target and a high refraction layer produced by a sputtering process using a conductive titanium

dioxide as a target.

34. The image display device according to claim 32 or 33, wherein the anti-reflection layer prevents a light reflection of which wavelength is 380 - 780 nm and a light reflection rate is not greater than 10 %.

35. An image display device which comprises an image display panel, in which the liquid powders, which indicate a high fluidity in an aerosol state such that solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the liquid powders, to which an electrostatic field produced by a pair of electrodes arranged on one substrate or both substrates is applied, are made to move so as to display an image, characterized in that two substrates of the image display panel are connected by using a thermosetting adhesive or a photo-curing adhesive.

36. The image display device according to claim 35, wherein the thermo-setting adhesive or the photo-curing adhesive includes one or more groups of compounds having one of glycidyl group, acrylic group and methacrylic group.

37. An image display device which comprises an image display panel, in which the liquid powders, which indicate a high fluidity in an aerosol state such hat solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substrates, at least one of two substrates being transparent, and, in which the liquid powders, to which an electrostatic field produced by a pair of electrodes having different potentials is applied, are made to move so as to display an image, characterized in that one or more image display elements are formed by using a partition wall and the partition wall has such a shape that a bottom width wb at a side of an opposed substrate is larger than a top width wt at a side of a transparent substrate.

38. The image display device according to claim 37, wherein a ratio wt/wb between the bottom width wb at a side of the opposed substrate and the top width wt at a side of the transparent substrate is not greater than 0.5.

39. The image display device according to one of claims 25 - 38, wherein an apparent volume in a maximum floating state of the liquid powders is two times or more than that in none floating state.

40. The image display device according to one of claims 25 - 29, wherein

a time change of the apparent volume of the liquid powders satisfies the following formula:

$V_{10}/V_5 > 0.8$;

here, V_5 indicates the apparent volume (cm^3) of the liquid powders after 5 minutes from the maximum floating state; and V_{10} indicates the apparent volume (cm^3) of the liquid powders after 10 minutes from the maximum floating state.

41. The image display device according to one of claims 25 - 40, wherein an average particle diameter d(0.5) of the liquid powders is 0.1 - 20 μm.

42. A method of manufacturing an image display device which comprises an image display panel, in which the liquid powders, which indicate a high fluidity in an aerosol state such that solid-like substances are suspended in a gas stably as dispersoid, are sealed between opposed two substances, at least one of two substrates being transparent, in which the liquid powders, to which an electrostatic field produced by a pair of electrodes having different potentials is applied are made to move so as to display an image, and, in which one or more image display elements are formed by using a partition wall, characterized in that the improvement comprises the steps of: forming the partition wall on one or both of a transparent substrate and an opposed substrate; arranging an adhesive at a tip of the partition wall; and connecting the partition wall and the other substrate or both partition walls through the adhesive.

43. The image display device according to claim 42, wherein an apparent volume in a maximum floating state of the liquid powders is two times or more than that in none floating state.

44. The image display device according to claim 42 or 43, wherein a time change of the apparent volume of the liquid powders satisfies the following formula:

$V_{10}/V_5 > 0.8$;

here, V_5 indicates the apparent volume (cm^3) of the liquid powders after 5 minutes from the maximum floating state; and V_{10} indicates the apparent volume (cm^3) of the liquid powders after 10 minutes from the maximum floating state.

45. The image display device according to one of claims 42 - 44, wherein an average particle diameter d(0.5) of the liquid powders is 0.1 - 20 μm.

46. An image display device characterized in that the improvement is

manufactured in accordance with the method of manufacturing the image display device set forth in one of claims 42 - 45.